SUMMERS ENGINEERING, INC.
CONSULTING ENGINEERS
887 N. IRWIN ST. - P. O. BOX 1122
HANFORD, CALIFORNIA 93232-1122

TELEPHONE
(559) 582-9237
FAX
(559) 582-7632

JOSEPH B. SUMMERS
1923-2006

JOSEPH C. McGAHAN
ROGER L. REYNOLDS
BRIAN J. SKAGGS
SCOTT L. JACOBSON
JAMES C. LINNEMAN

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Mr. Fethi Benjemaa
California Department of Water Resources
Water Use Efficiency Branch
SBX7-7 Program
P.O. Box 94236-001

Subject: Comments on Calculation of Agricultural Water Use Efficiency

Dear Mr. Benjemaa:

At the August 8th meeting of the Agricultural Stakeholder Subcommittee (ASC) Efficiency of Agricultural Water Use Subcommittee (A1) Attachment D was presented summarizing possible metrics for the development of a methodology to estimate agricultural water use efficiency. Comments were requested.

As DWR and the subcommittee move forward, there is a need to look at a specific example to better understand the factors involved in implementing a consumptive use fraction or some other type of metric to reasonably quantify irrigation efficiency for the Legislature. An example of an Irrigation Use Analysis prepared by Summers Engineering is attached. The metric used is a typical irrigation efficiency calculation used by DWR in previous California Water Plans, by Dr. Robert Hagen, UC Davis, and many others to estimate the effectiveness of a region or district's irrigation practices and management.

The calculation used in this example is straightforward. Many would say a metric like this should be the basis of the proposed methodology for quantifying the efficiency of agricultural water use. There is a need to clearly understand, however, the labor required, and the estimates and assumptions needed to calculate water use efficiency for a given district or region in this manner would be quite significant.

The example provided lists a tabulation of the different crop acreages in the district. One question is how accurate is the crop acreage tabulation. County roads, farm roads and levees will alter the acreage numbers. An Estimated Annual District Crop Evapotranspiration rate needs to be developed for the district for the year an irrigation analyses is made. This will typically be estimated using CIMIS data for the previous

year. These assumptions could be impacted by the actual crop growing season which may vary over the region and by which CIMIS station data is utilized. Some districts may also have different micro-climates but only one nearby CIMIS Station. Some of the annual precipitation usually provides a portion of a crop's annual water requirement. There are different methods for calculating this Effective Precipitation and using a different method will change the amount calculated. The example also lists some estimated district delivery losses. To accurately estimate the efficiency of water delivered to a farmer, a district will need to know their delivery system losses. Often a district with open canals would not know the exact seepage, evaporation, or spill losses occurring, and will have to estimate them. Often individual farmers within a district have private wells which they pump, if necessary, to meet their crop water requirements. An estimate of this water supply has to be made. The District Irrigation Efficiency calculation also includes a leaching requirement or cultural practice needs. There is a basis for including these added water supply requirements, but they are a reasonable estimate of the amount of water required not a measured value.

To be clear, the attached method is provided as an example, not a recommendation. However, it indicates no matter what irrigation efficiency calculation or metric is developed as a methodology for quantifying the efficiency of irrigation water use, numerous assumptions and estimates will still be needed to actually calculate the efficiency, and this will take a district or region a significant amount of additional work and costs to accomplish. I am hopeful the final methodology developed can be simple and straight forward taking into account the difficulty and the assumptions and estimates which will be needed to reasonably calculate or quantify the efficiency of California's agricultural water use.

Very truly yours,

Roger L. Reynolds

EXAMPLE IRRIGATION USE ANALYSIS

CROP ACREAGE	TOTAL ACRES	Adj. ETc* (in.)	Effective ** Precipitation (in.)	Estimated Total Crop Water Requirement (in.)	(A.F./Acre)	(A.F.)
BARLEY	4,774	22.7	11.00	11.70	0.98	4,655
WHEAT	7,953	24.1	11.00	13.10	1.09	8,682
ALFALFA HAY	7,598	41.8	11.00	30.80	2.57	19,502
OTHER HAY	244	41.8	11.00	30.80	2.57	626
IRRIGATED PASTURE	2,978	43.3	11.00	32.30	2.69	8,016
BEANS, DRY AND EDIBLE	1,555	25.2	11.00	14.20	1.18	1,840
HERBS AND SPICES	155	30.4	11.00	19.40	1.62	251
SUGAR BEETS	7,610	37.5	11.00	26.50	2.21	16,805
SAFFLOWER OIL	1,542	22.7	11.00	11.70	0.98	1,503
CARROTS	48	30.4	11.00	19.40	1.62	78
CORN, SWEET (POPCORN)	223	32.6	11.00	21.60	1.80	401
CORN (FRESH MARKET)	23	22.6	11.00	11.60	0.97	22
CUCUMBERS	49	30.4	11.00	19.40	1.62	79
PUMPKINS	57	30.4	11.00	19.40	1.62	92
WATERMELONS	49	30.4	11.00	19.40	1.62	79
GARLIC	16	30.4	11.00	19.40	1.62	26
TOMATOES (CANNING)	7,766	30.4	11.00	19.40	1.62	12,555
TOMATOES (FRESH MARKET)	98	30.4	11.00	19.40	1.62	158
TOTAL NURSERY	557	30.4	11.00	19.40	1.62	900
CUCURBITS	438	30.4	11.00	19.40	1.62	708
ONIONS	79	30.4	11.00	19.40	1.62	128
SUNFLOWER	1,347	30.4	11.00	19.40	1.62	2,178
APRICOTS	120	36.9	11.00	25.90	2.16	259
CHERRIES	61	36.9	11.00	25.90	2.16	132
PERSIMMONS	15	36.9	11.00	25.90	2.16	32
KIWI	87	32.5	11.00	21.50	1.79	156
GRAPES, OTHER	1,365	32.5	11.00	21.50	1.79	2,446
PEACHES	209	36.9	11.00	25.90	2.16	451
PEARS	1,651	36.9	11.00	25.90	2.16	3,563
PRUNES AND PLUMS	1,762	36.9	11.00	25.90	2.16	3,803
ALMONDS	245	41.0	11.00	30.00	2.50	613
WALNUTS	1,179	41.0	11.00	30.00	2.50	2,948
FAMILY GARDENS AND ORCHARDS	270	41.0	11.00	30.00	2.50	675
Totals	**52,123**					**94,362**

* Adj. ETc = Estimated Annual District Crop Evapotranspiration. Note that Kc values for some crops are region-specific and not universally available. Large regions would need to be divided into sub-regions to account for variations in ET.

** Estimated Effective Precipitation calculated from U.S. Weather Station or CIMIS data. Large regions would need to be divided into sub-regions to account for variations in rainfall.

WATER SUPPLY	
-District Surface Deliveries	119,064 AF
-Estimated 10% District Delivery Losses	(11,906) AF
-District Groundwater Pumping	2,311 AF
-Estimated Non-District Groundwater Pumping	5,000 AF
-Reclaimed Water	3,200 AF
-Recovered Water	1,472 AF
TOTAL APPLIED WATER =	**119,141 AF**

District Irrigation Efficiency (DIE) = ((Crop Water Requirement + LR) / Total Applied Water) x 100

LR = Leaching Requirement (Calculated at 4000 AF/YR)

DIE = ((94,362 AF + 4000 AF) / 119,141 AF) x 100 = 83%

Calculation of DIE:

This analysis requires a significant amount of work to obtain and tabulate the data needed for calculation of the DIE. The assumptions and estimates required to calculate the DIE are highlighted in yellow. These assumptions could vary significantly from district to district and even within a district, as well as from year to year. Additionally, this method does not account for individual irrigation methods or variations in grower cultural practices. At best it provides a reasonable satellite-level view of regional irrigation efficiency.